

coverage and the conformity due to the dental implant for nasopharyngeal cancer (NPC) group (implant outside the PTV). However, for the Non-NPC group (implant inside the PTV), a large discrepancy was obtained in all PTV parameters. There were statistically significant differences ($P < 0.05$) in PTVmax, PTVmean, Conformation Number and volume covered with 70Gy (V70Gy) among models. A large portion of PTV was underdosed. For the stainless steel, the V70Gy is below 70%, which is 25% poorer when compared with AAA plans. In the phantom study, ionization chamber and film measurements supported the dose perturbations by AXB. Using a 3% and 3mm criteria Gamma analysis, passing rate was between 95.0% and 99.7% demonstrating that AXB was in agreement with measurements in different models.

Conclusion: The effect of high density dental material in H&N IMRT cases highly depends on the location of the PTV. For the case with implant outside the PTV, the impact is independent of the type of material and zirconia is recommended for material assumption. However, for the cases with implant inside the PTV, assumption of material should not be made without proper investigation.

EP-1576

Evaluation of transit in vivo dosimetry using portal imaging in VMAT treatment plans

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Purpose or Objective: To assess the performance of the EPIgray® software in the field of transit in vivo dosimetry using portal imaging in Volumetric Modulated Arc Therapy (VMAT) treatment plans.

Material and Methods: MV images acquired in cine mode using portal imaging were used by EPIgray® to reconstruct the delivery dose. These reconstructed doses were compared to the calculated doses obtained by the TPS. The reproducibility of the response was evaluated first on phantom and on patient with a prostate VMAT treatment plan and also on patient with a more complex head and neck plan. The dose deviation, with checkpoints defined in the PTV and the organ at risks, was our main criteria to verify the reproducibility of the response. The dose tolerance was set of $\pm 5\%$. The relevance and performance of the points automatically generated (AUTO VX) by the software on PTV have been tested and compared with points generated by the user. Then, data from 101 patient's cases treated by VMAT plans (various locations) were retrospectively analyzed taking into account only the dose deviation of the automatic control point AUTO VX.

Results: The dose deviation from the VMAT treatment plan (phantom and patient) measurements ranged of 0.26 % to 1.50 %, respectively. The dosimetric study on head and neck treatment showed a variable dose deviation range 0.87% and 2.5% depending on level of dose. Automatic points and points created by the user have similar results. The point AUTO VX is representative of results of all points. Results from patient's cases were $1.31 \pm 1.62\%$ for the prostate and $-4.79 \pm 3.87\%$ (AUTO V1) and $-5.54 \pm 3.74\%$ (AUTO V2) for the head and neck VMAT treatment plans. The first clinical results give 46 % patient's cases out-of tolerance. The relative difference in the overall results was $-4.68 \pm 3.50\%$.

Conclusion: EPIgray® gives reproducible results on phantom and for treatments such as prostate VMAT treatment plans. The software seems to be less efficient with more complex VMAT treatment plans such as head and neck cases. This study allowed us to consider a tolerance to own each tumor site.

EP-1577

A robust method to minimize geometric table rotational errors in stereotactic radiotherapy

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Purpose or Objective: In stereotactic radiotherapy of intracranial lesions typically non-coplanar techniques are used. However, if the table rotation axis does not coincide with the linac's MV isocentre, the non-coplanar arc introduces a geometric shift of the patient. We present a method to measure the table rotational error for the Elekta® Precise table and correct for this error by moving the table assembly.

Material and Methods: The table rotation axis is measured with respect to the linac's MV isocentre. To determine the MV isocentre position, first an EPID-based Winston-Lutz measurement is performed. Subsequently, without moving the ball bearing (BB), EPID images at gantry angle α are acquired at different table angles (-90° , -45° , 0° , 45° and 90°). For each image, the position of the field and BB is determined by an automated fitting procedure.

The table rotational error is calculated by applying two corrections to the measured positions. 1) To correct for the difference between the field centre from gantry 0 and the MV isocentre, all BB positions are shifted by this calculated difference. 2) The BB position at table angle 0 is translated to the MV isocentre, and for the other BB positions the same translation vector is rotated by the table angle. The final corrected positions represent the geometric shift of the BB due to table rotation as if it was placed exactly at the MV isocentre. The largest geometric shift is defined as the table rotational error. This error indicates the possible geometric shift of the patient caused by table rotation when applying a non-coplanar arc.

In order to minimize the table rotational error, the entire table assembly must be shifted. The required shift equals the difference between the table rotation axis and the MV isocentre. This difference is determined from a semicircle which is fitted to the corrected BB positions for the different table angles. To accurately adjust the ~800 kg table assembly, a digital indicator with an accuracy of 0.01 mm and a crowbar are used.

The stability of the adjusted table assembly was ensured by performing a monthly measurement of the table rotational error.

Results: Six Elekta® Precise tables were successfully corrected (see figure 1). After adjustment, the table rotation axis coincided with the MV isocentre to within on average 0.3 ± 0.1 mm (max. 0.6 mm). This resulted in an average table rotational error, i.e. maximal possible geometric shift, of 0.5 ± 0.2 mm (max. 1.0 mm). Monthly measurements showed that the table rotational error of all six tables were stable with a standard deviation of 0.1 mm.

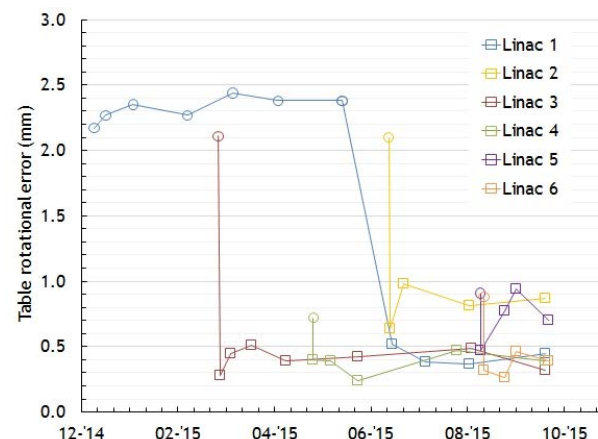


Figure 1 Table rotational error of six tables.

Conclusion: We present a robust method to accurately measure and correct the table rotational error. This makes it possible to coincide the table rotation axis with the linac's MV isocentre within on average 0.3 mm. The stability after adjustment shows that the method is useful and effective. This method improves the delivery accuracy of non-coplanar stereotactic radiotherapy.

EP-1578

Evaluation of an Integral Quality Monitor device for monitoring real-time delivery

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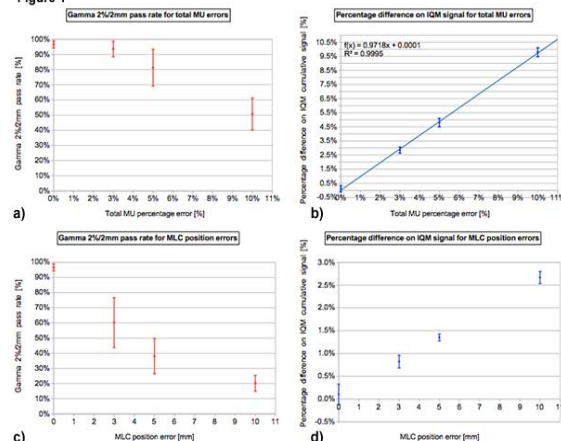
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Purpose or Objective: Radiotherapy treatments are getting more and more complex, dealing with the continuous development of new technologies. Therefore, it is of increasing importance monitoring delivered beams to identify errors. The use of a linac-head integral quality monitor (IQM, iRT Systems GmbH) for real-time beam delivering control was evaluated. This study analyzed the effect of IQM attenuation on delivered beams and the ability of IQM in detecting errors in VMAT treatments.

Material and Methods: Beam attenuation was calculated at 4 different beam size (from 5x5 to 20x20 cm²) by the IC Profiler (Sun Nuclear Corp.) at 6 MV and 10 MV beam energies in both X and Y directions. The IQM capability in recognizing errors was performed introducing deviations in 4 H&N clinical VMAT plans: 3, 5 and 10 % errors on total delivered MU's and 3, 5 and 10 mm MLC's shifts. The cumulative IQM checksum value was measured and the percentage difference was calculated with respect to the non-modified plan. At the same time we obtained dose distribution maps through the PTW 2D array inserted in a rotating QA phantom (RT-smartIMRT, dose.point GmbH). The phantom was chosen for its geometrical characteristics similar to IQM in signal recollection. The local gamma pass rates (2%/2mm) were compared to the original plan values. Non-modified plans were delivered twice in two different times to take into account LINAC variations.

Results: Beam attenuations were normalized to the central chamber of IC Profiler. It gives average attenuation values of 6.56 % \pm 0.03 % and 5.27 % \pm 0.12% for 6 MV and 10 MV beams, respectively. The percentage of dose difference with respect to the central chamber value was assessed to be < 0.4 % for the 6 MV beam and < 0.1 % for the 10 MV beam excluding beam penumbra regions. The results for modified VMAT plans are summarized in Figure 1. Figure 1a and 1b shows the gamma pass rates and the IQM signal percentage differences for MU's variations, respectively. Figure 1c and 1d illustrates the results for MLC shifts. Both methods detect specifically MLC shift errors, while MU's variations were better identified by IQM. IQM shows a linear response with dose while gamma analysis seems to have difficulty in identifying 3% and 5% MU's variations. In our opinion the reason for this is that the RT-smartIMRT recollect a 2D dose map as if the entire plan were delivered at a fixed gantry angle. Further comparisons to gamma analysis should be evaluated with a different kind of phantom.

Figure 1



Conclusion: IQM beam attenuation can be considered to be homogenous in both X and Y directions and the machine-specific percentage of beam attenuation could be used to rescale treatment plan dose for clinically IQM use. The IQM shows outstanding features in detecting real-time errors and for time-saving QA's, although the characterization of IQM responses to single segment errors and the definition of a machine-specific alarm threshold still have to be analyzed.

EP-1579

Room scatter effects in Total Skin Electron Therapy: a Monte Carlo study

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Purpose or Objective: Total Skin Electron Irradiation (TSEI) is a complex technique which involves the use of large electron fields. Electrons scattered from the treatment room floor and ceiling might contribute to skin dose and distort dose distribution, especially when dual-field approach is used. The purpose of this work is to study effects of scattered electrons on the dosimetry of TSEI by Monte Carlo (MC) simulations.

Material and Methods: 6 MeV and 9 MeV beams from Elekta Precise linac operated in High-Dose-Rate (HDR) mode are used for TSEI treatments. The EGSnrc code package was used for MC simulation. First, the incident electron beam parameters (energy spectrum, FWHM) were adjusted to match the measured data (PDD and profile) for both energies at SSD=100 cm for 40x40 open field. These parameters were then used to calculate vertical dose profile at 1mm depth at the treatment distance of 400 cm. Floor was modeled within BEAMnrc using JAWS module. LATCH variable was used to track electrons history and calculate dose profile with and without electrons scattered from the floor. Dose profiles were normalized to the maximum dose from one horizontal field (gantry angle 90 degrees) at 1 mm depth. Influence of dual field angle and floor material on the contribution of floor scatter was investigated. Spectrum of the scattered electrons was calculated. Measurements of dose profile were performed in order to verify MC calculations.

Results: Vertical profile total dose, dose without floor scatter and the floor scatter contribution is shown in Figure 1. Floor scatter contribution is more than 20% near the floor and decreases to about 10% and 5% at the distance 50cm and 100cm from the floor, respectively. No dependence on the beam energy or dual-field angle was found. The scatter depends on the floor material (at 20 cm from the floor, scatter contribution was about 18%, 15% and 12% for concrete, PVC and water, respectively). Spectrum of the scattered electrons has distribution which is almost uniform between few hundred KeV to 4 MeV and then decreases linearly to 6 MeV. Dose verification measurements for the total dose were in good agreement (less than 3%) with the MC calculations.